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10/748,546	12/30/2003	Alex Nugent	1000-1215	9090

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EXAMINER	
HIRL, JOSEPH P	

ART UNIT	PAPER NUMBER
2129	

DATE MAILED: 08/18/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/748,546	NUGENT, ALEX	
	Examiner	**Art Unit**	
	Joseph P. Hirl	2129	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 June 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *30 December 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *07/09/06*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This Office Action is in response to an AMENDMENT entered June 13, 2006 for the patent application 10/748,546 filed on December 30, 2003.

2. The First Office Action of April 24, 2006 is fully incorporated into this Final Office Action by reference.

Status of Claims

3. Claims 1-20 are pending.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Widrow (USPN 3, 222,654, referred to as **Widrow**).

Claim 1

Widrow anticipates a physical neural network (**Widrow**, c1:10-14; c1: 40-48; Examiner's Note (EN): ¶ 13 applies), comprising a liquid state machine (**Widrow**, c4:34-55); wherein said physical neural network comprises nanotechnology-based

connections located within a dielectric solvent between pre-synaptic and post-synaptic electrodes thereof (**Widrow**, c4:35-65), such that said nanotechnology-based connections are strengthened or weakened according to an application of an electric field, a frequency or a combination thereof to provide physical neural network connections thereof (**Widrow**, c4:35-65).

Claim 2

Widrow anticipates liquid state machine comprises a dynamic fading memory mechanism (**Widrow**, c4:59-73; c7:50-59; EN:, the process of hysteresis exhibits a fading memory mechanism in which memory is lost through repeated application of the electric field given the particular electrolytic solution described within).

Claim 3

Widrow anticipates a supervised learning mechanism associated with said liquid state machine (**Widrow**, c1:34-65), whereby connections strengths of said molecular connections are determined by pre-synaptic and post7synaptic activity respectively associated with said pre-synaptic and post-synaptic electrodes (**Widrow**, c2:13-24; c3:3-18; c4:34-55).

Claim 4

Widrow anticipates supervised learning mechanism comprises at least one perceptron (**Widrow**, c2:40-43; c3:18-47; c4:34-55).

Claim 5

Widrow anticipates mechanism learns via feedback obtained from said post-synaptic electrodes (**Widrow**, c1:45-55; c4:3-19).

Claim 6

Widrow anticipates supervised learning mechanism comprises a linear read out mechanism (**Widrow**, c3:17-57).

Claim 7

Widrow anticipates supervised learning mechanism evolves based on an activity depending learning rule (**Widrow**, c1:36-55).

Claim 8

Widrow anticipates supervised learning mechanism evolves based on pre-synaptic and post-synaptic activity, including a voltage, frequency, or a combination thereof (**Widrow**, c1:45-64; c2:1-2; c4:24-73; c4:49-55).

Claim 9

Widrow anticipates nanotechnology-based connections comprise nanoparticles (**Widrow**, c4:24-73).

Claim 10

Widrow anticipates nanotechnology-based connections comprise nanoconductors (**Widrow**, c4:24-73; EN: ¶ 13 applies; see definition below concerning nanotechnology).

Claim 11

Widrow anticipates a connection network also comprising a plurality of said nanotechnology-based connections (**Widrow**, c4:24-73).

Claims 12, 18

Widrow anticipates a physical neural network (**Widrow**, c1:10-14; c1: 40-48; EN: ¶ 13 applies), comprising a liquid state machine (**Widrow**, c4:34-55); wherein said physical neural network comprises nanotechnology-based connections located within a dielectric solvent between pre-synaptic and post-synaptic electrodes thereof (**Widrow**, c4:35-65), such that said nanotechnology-based connections are strengthened or weakened according to an application of an electric field, a frequency or a combination thereof to provide physical neural network connections thereof (**Widrow**, c4:35-65); and a supervised learning mechanism associated with said liquid state machine (**Widrow**, c1:34-65), whereby connections strengths of said nanotechnology-based connections are determined by pre-synaptic and post-synaptic activity respectively associated with said pre-synaptic and post-synaptic electrodes (**Widrow**, c2:13-24; c3:3-18; c4:34-55; EN: ¶ 13 applies; see definition below concerning nanotechnology), wherein said liquid state machine comprises a dynamic fading memory mechanism (**Widrow**, c4:59-73; c7:50-59).

Claim 13

Widrow anticipates supervised learning mechanism comprises at least one perceptron (**Widrow**, c2:40-43; c3:18-47).

Claim 14

Widrow anticipates supervised learning mechanism learns via feedback obtained from said pre-synaptic and post-synaptic electrodes (**Widrow**, c1:45-55; c4:3-19; EN: feedback is axiomatic to the training of a neuron).

Claim 15

Widrow anticipates supervised learning mechanism comprises a linear read out mechanism (**Widrow**, c3:17-57).

Claim 16

Widrow anticipates supervised learning mechanism evolves based. on post-synaptic activity, including a voltage, frequency, or a combination thereof (**Widrow**, c1:45-65; c2:1-2; c4:24-73).

Claim 17

Widrow anticipates nanotechnology-based connections comprise nanoconnections (**Widrow**, c4:24-73; EN: ¶ 13 applies; see definition below concerning nanotechnology).

Claim 19

Widrow anticipates at least one connection network associated with at least one neuron-like node (it remains inherent for a neural network to comprise a connection network as one can not exist without its respective connections), wherein said at least one connection network comprises a plurality of said nanoconnections, including a plurality of interconnected nanoconductors (**Widrow**, c4:59-73); wherein each nanoconductor of said plurality of interconnected nanoconductors is strengthened or weakened according to an application of an electric field or frequency thereof (**Widrow**, c4:24-73; c4:49-55).

Claim 20

Widrow anticipates each nanoconductor of said plurality of interconnected nanoconductors experiences an increase in alignment in accordance with an increase or a decrease in said electric field, said frequency, or said combination thereof (**Widrow**, c4:49-55; EN: inherently when an electric field is applied to any dipolar particle, such as the nanoconnections described above, it will become aligned accordingly under the physical properties of electricity); wherein nanoconductors of said plurality of interconnected nanoconductors that are utilized most frequently by said at least one neuron-like node become stronger with each use thereof (**Widrow**, c4:24-73; c4:49-55); and wherein nanoconductors of said plurality of interconnected nanoconductors that are utilized least frequently become increasingly weak and eventually become unaligned (**Widrow**, c4:24-73; c4:49-55).

Response to Arguments

6. The objection to claim 10 under 37 CFR 1.75(c) is withdrawn.

7. The objection to claim 19 under 37 CFR 1.67 is withdrawn.

8. The rejection of claim 11 under 35 USC 112, second paragraph, is withdrawn.

9. Applicant's arguments filed on June 13, 2006 related to Claims 1-20 have been fully considered but are not persuasive.

Examiner's Note (EN): Applicant has not defined the term Nanotechnology. From the web @ www.answers.com/nanotechnology, the following definition was obtained:

Nanotechnology: the science and technology of building devices, such as electronic circuits, from single atoms and molecules.

From Nanotechnology web site created by Dr. Ralph Merkle, the statement is made that the "word nanotechnology has become very popular and is used to describe many types of research where characteristic dimensions are less than about 1,000 nanometers" (micron range). http:www.zyvex.com/nano/

Applicant has not defined "nanotechnology" related to a specific numeric scale. However, applicant has made the following size comparison @ specification, page 6, lines 10-13:

> Microelectrical nano-size components include transistors, resistors, capacitors and other nano-integrated circuit components. MEMS devices include, for example, micro-sensors, micro-actuators, microinstruments, micro-optics, and the like.

Such definition is entirely consistent with the above cited definitions/intent.

Person having ordinary skill in the art (PHOSITA) would be knowledgeable of the intent of the word "nanotechnology." Examiner will use this "intent" in the examination of the application. PHOSITA would also be knowledgeable of Neural Networks of which many textbooks and related technical papers are available in the community, an example of which is the "Elements of Artificial Neural Networks" by Kishan Mehrotra et al and published by MIT in 1997

In reference to Applicant's argument:

The Applicant respectfully disagrees with this assessment. Applicant's amended claim 1 is directed toward the following claim limitations: A neural system based on nanotechnology, comprising: a physical neural network comprising a liquid state machine, wherein said physical neural network comprises nanotechnology based connections located within a dielectric solvent between pre-synaptic and post-synaptic electrodes thereof, such that said nanotechnology-based connections are strengthened or

weakened according to an application of an electric field, a frequency or a combination thereof to provide physical neural network connections thereof.

The Examiner cited C 4, L34-55 in attempt to argue that Widrow teaches an LSM (Liquid State Machine) as taught by Applicant's Invention. The Applicant provides a particular teaching for an LSM at, for example, paragraphs [00328] [00329] of Applicant's specification as follows:

> [00328] FIG. 39 illustrates a system 3900 of Interconnected neural circuitry referred to in the art as a Liquid State Machine, which can be adapted for use in accordance with an alternative embodiment of the present invention. Physical neural network 3900 thus comprises a Known" enabled liquid state machine. System 3900 generally describes a neural network learning mechanism which can be applied to a physical neural network formed utilizing nanotechnology, as described herein. Such a network generally consists of two or more distinct neural modules. Inputs are presented to the first module, referred to as a Liquid State Machine or LSM. The LSM is generally a randomly connected network of neural circuits. Although the connections may be random, this is not always the case. Generally, the exact nature of the connections are not as important as the statistics of the connection, such as the amount of interconnectivity. However such a LSM is connected, its sole purpose is to provide what is referred to in the art as an "analog fading memory". In a liquid state machine, memory tends to fade, similar to the fading of ripples associated with liquid, such as water, as a result of input (e.g., a rock thrown in a pond) to the liquid or water at various times and locations thereof.
>
> [00329] The LSM can store, via patterns of neural activations, it's recent past history. Other types of neural circuits can be utilized to extract the "state" of the LSM. A state extracting neural circuit can be accomplished by a very simple learning neuron, such as, for example, a perceptron. Such perceptrons can adjust their synaptic weights so as to produce a desired output. Such perceptrons can be referred to as a "read-out" neuron. The exact rule that the read-out neurons utilize may vary, but in general such read-out neurons can form a simple linear mapping between the neural circuits within the LSM and the read-out neuron output.

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. All of the features identified by the applicant have been anticipated by relevant sections of Widrow et al above. The intent of the word “Nanotechnology” was further established above. The First Office Action applies.

In reference to Applicant's argument:

There is simply no teaching in Widrow of an LSM that stores, via patterns of neural activations, it's recent past history, nor of an LSM that provides "analog fading memory". Contrary to the Examiner's assertion,

C 4, L34-55 of Widrow and the discussion of the electrode and liquid electrolyte that changes state to reflect changes in information, via resistivity, of Widrow, is not an LSM as taught by Applicant's invention. The Examiner has seemingly interpreted a liquid state machine to mean that the device exists in a liquid when in fact the term is used to describe the dynamics of the neural algorithm and has nothing to do with liquid. The electrode, liquid electrolyte and resistivity of Widrow do not result in a device that can store, via patterns of neural activations, it's recent past history. In fact, this is impossible because the circuit(s) disclosed by Windrow do not possess the correct topology to function as a Liquid State Machine. More specifically, a liquid state machine requires feedback to circulate neural activations within the network to act as an analog fading memory. Feed-forward neural networks do not possess these feedback connections and consequently do not provide for "analog fading memory" as taught by Applicant's invention.

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. It is axiomatic that training requires feedback. Widrow anticipates training and consequently feedback (Widrow, c4:17-18).

In reference to Applicant's argument:

Additionally, Widrow does not disclose, suggest or teach a "physical neural network" as taught by Applicant's Invention. Applicant's specification refers to particular type of physical neural network, one which is based on nanotechnology. Widrow does not provide for a teaching and/or disclosure or such molecular technology (e.g., nanotechnology) as a basis for forming a physical neural network. In particular, Widrow does not provide a teaching for a nanotechnology-based neural network in which molecular neural connections are formed in a dielectric solution. C 1-l2 of Widrow does not provide for any teaching of neural network connections formed in a dielectric solution. Additionally, C 1, L 10-14 and L 40-48 of Widrow cited by the Examiner does not provide for any teaching of a physical neural network as taught by Applicant's claims and specification. The mere presence of "an adaptive or learning logic network that automatically modifies its own structure" does not provide for a disclosure and/or teaching of the physical neural network taught by Applicant's invention. How does an "adaptive or learning logic network" constitute a physical neural network formed from nanotechnology as taught by Applicant's invention?

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not

read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Nanotechnology's intent is as identified above. The circuit of Widrow's Fig. 1 identifies a neuron network.

In reference to Applicant's argument:

Regarding the assertion that C 4, L 35 - L 65 of Widrow teach pre- and postsynaptic electrodes, the Applicant notes that C 4, L 35 - L 65 does not provide for any teaching of pre and post synaptic electrodes as taught by Applicant's invention. In fact, C 4, L 35 - L 65 does not even refer to a synapse, let alone a physical neural network. The leads 21 and 22 of Widrow are just that - leads, and do not provide for any teaching of pre and post synaptic electrodes as taught by Applicant's invention, nor any disclosure, hint or suggestion of molecular (e.g., nanotechnology) physical neural network connections formed in a dielectric network and which can be strengthened or weakened according to an application of an electric field, a frequency of a combination thereof. C 4, L 24-27 and C 4, 49-55 does not disclose these features. The Examiner's argument that a frequency Is inherent in an alternating current, does not provide for any teaching of the physical neural network connections formed in a dielectric solution as taught by Applicant's invention or the strengthening or weakening of such neural network connections according to an application of an electric field, a frequency of a combination thereof. Changing the alternating current of Widrow does not result in the use of a frequency to alter neural network connections formed in a dielectric solution (Note: Widrow does not teach such a dielectric solution). Widrow simply provides no teaching of using frequency to strengthen or weaken neural network connections formed in a dielectric solution. It should also be pointed out that that the invention disclosed by Widrow and Applicant's invention are based on completely different physical mechanisms, i.e., electrochemical (Widrow) versus electromechanical (Applicant). Any extrinsic similarities are erroneous because the underlying intrinsic physical mechanisms that enable each device are completely different from one another. One rather apparent example of the different underlying physical mechanisms is simply that the device disclosed by Widrow requires three terminals to operate, whereas the device disclosed by the Applicant requires only two (e.g., a pre- and post-synaptic electrode). The Applicant respectfully asks the examiner to explain how the invention of Widrow can be made to accomplish the tasks of Applicant's Invention with the use of only two electrodes?

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. All points raised by applicant have been addressed in the First Office Action. The question applicant has proposed is not relevant since the claims of

the applicant are not limited to merely two electrodes. Note that in claim 1 "pre-synaptic and post-synaptic electrodes" is not limiting to just two electrodes.

In reference to Applicant's argument:

It is important to note that Widrow also simply does not provide for any teaching of the nanotechnology-based connections of Applicant's invention. The nanotechnology-based connections of Applicant's invention are based on technologies that did not even exist at the time of Widrow. That is, the nanotechnology-based connections of Applicant's invention utilize components such as nanotubes, nanowires, nanoparticles and so forth. Such nanotechnology-based components and process are not taught or disclosed by Widrow, as they did not exist at the time.

It is important to note that Widrow does not provide for any teaching of nanotechnolgy, (or microfabrication for -that matter). Applicant's specification, on the other hand, provides for a teaching of nanotechnology (see paragraphs 00160017 of Applicant's specification) as follows:

> "[0016] The term "Nanotechnology" generally refers to nanometer-scale manufacturing processes, materials and devices, as associated with, for example, nanometer-scale lithography and nanometer-scale Information storage. Nanometer-scale components find utility in a wide variety of fields, particularly in the fabrication of microelectrical and microelectromechanical systems (commonly referred to as "MEMS"). MIcroelectrical nano-sized components include transistors, resistors, capacitors and other nano-integrated circuit components. MEMS devices include, for example, micro-sensors, micro-actuators, micro-Instruments, micro-optics, and the like.
> [0017] In general, nanotechnology presents a solution to the problems faced in the rapid pare of computer chip design in recent years. According to Moore's law, the number of switches that can be produced on a computer chip has doubled every 113 months- Chips now can hold millions of transistors. It is, however, becoming increasingly difficult to increase the number of elements on a chip utilizing existing technologies. At the present rate, in the next few years the theoretical limit of silicon-based chips will have been attained. Because the number of elements and components that tan be manufactured on a chip determines the data storage and processing capabilities of microchips, new technologies are required for the development of higher performance chips."

There is absolutely no teaching in Widrow for such nanotechnology. Where are nanometer scale (or less) components taught by Widrow? The device, as disclosed by Widrow, was contained in a glass vile and is implemented on the scale of centimeters, not nanometers. A review of Widrow does not indicate any disclosure of nanometer scale components such as nanotubes, nanowires, nanoparticles and the like. Widrow also does not provide, for example, any disclosure or teaching of nanometer-scale manufacturing processes, materials and devices. The Examiner has not provided any evidence from Widrow which indicates otherwise.

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not

read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Intent of "nanotechnology" has been addressed above.

In reference to Applicant's argument:

Additionally, it is important to note that Widrow does not even provide any teaching or disclosure of a neural network. Where is a teaching of a neural network in Widrow? Widrow provides no teaching of a neural network as taught by Applicant's Invention. There is no hint or suggestion of neural network components such as synapses, neurons and so forth. The "logic memory" taught by Widrow provides no indication of a neural network and in particular, no teaching of a physical neural network as taught by Applicant's invention.

In order to function as a neural network, the device of Widrow must have certain components Inherent to a neural network, such as synapses, neurons and so forth. Applicant's specification at paragraphs [009-0014] generally describes some of the features of a neural network and the problems with hardware versus software Implementations of neural networks:

> Neural networks that have been developed to date are largely software based. A true neural network (e.g., the human brain) is massively parallel (and therefore very fast computationally) and very adaptable. For example, half of a human brain can suffer a lesion early in its development and not seriously affect its performance. Software simulations are slow because during the learning phase a standard computer must serially calculate connection strengths. When the networks get larger (and therefore more powerful and useful), the computational time becomes enormous.
>
> For example, networks with 10,000 connections can easily overwhelm a computer. In comparison, the human brain has about 100 billion neurons, each of which can be connected to about 5,000 other neurons. On the other hand, If a network is trained to perform a specific task, perhaps taking many days or months to train, the final useful result can be built or "downloaded" onto a piece of hardware and also mass-produced. Because most problems requiring complex pattern recognition are highly specific, networks are task-specific. Thus, users usually provide their own, task-specific training data.
>
> A number of software simulations of neural networks have been developed. Because software simulations are performed on conventional sequential computers, however, they do not take advantage of the inherent parallelism of neural network architectures. Consequently, they are relatively slow. One frequently used measurement of the speed of a neural network processor is the number of interconnections it can perform per second.
>
> For example, the fastest software simulations available can perform up to approximately 18 million interconnects per second. Such speeds, however, currently require expensive super computers to achieve. Even so, approximately 18 million interconnects per second is still too slow to perform many classes of pattern classification tasks in real time. These include radar target classifications, sonar target classification, automatic speaker identification, automatic speech recognition, electro-cardiogram analysis, etc.
>
> The implementation of neural network systems has lagged somewhat behind their theoretical potential due to the difficulties in building neural network hardware. This is primarily because of

> the large numbers of neurons and weighted connections required. The emulation of even of the simplest biological nervous systems would require neurons and connections numbering in the millions and/or billions.
>
> Due to the difficulties in constructing such highly interconnected processors, currently available neural network hardware systems have not approached this level of complexity. Another disadvantage of hardware systems is that they typically are often custom designed and configured to implement one particular neural network architecture and are not easily, if at all, reconfigurable in implementing different architectures. A true physical neural network chip. with the learning abilities and connectivity of a biological network. has not yet been designed and successful implemented.

Widrow does not teach weighted connections, nor neurons, synapse, nor a device which can emulate a simple biological neural network. Again, the Applicant asks, where and how is a neural network taught by Widrow?

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Fig. 1 has weighted connections. PHOSITA would recognize Widrow and Fig. 1 as fundamental to the concepts of neural networks.

In reference to Applicant's argument:

The Applicant respectfully disagrees with this assessment. Widrow at C 1-12 and particularly C 4, L 59-73, does not teach a dynamic fading mechanism as taught by Applicant's invention. The dynamic fading memory, as taught by the Applicant's invention, is a network property, not a synaptic property. In other words, the dynamics of the synaptic connection do not play a significant role in the networks ability to retain a memory trace because the memory trace is retained the pattern of neural activation. The Applicant suggests that the Examiner re-read the Applicant's description of a Liquid State Machine and its use of an analog fading memory, particularly paragraphs 00328 and 00329 where it states:

'_the exact nature of the connections are not as important as the statistics of the connection, such as the amount of interconnectivity."

And...

"...LSM can store, via patterns of neural activations, its recent past history. "

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not

read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Applicant's argument is not proper.

In reference to Applicant's argument:

The Examiner's comparison of an analog fading memory to a hysteresis effect on an electroplating device Is irrelevant because it is the pattern of connectivity, not the behavior of a connection element, that is important in an analog fading memory.

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Claim 2 simply does not set forth such a limitation.

In reference to Applicant's argument:

Additionally, the Applicant notes that Widrow could not possibly provide a teaching of strengthening connections via pre- and post-synaptic activity because the device described by Widrow does not modify its resistance via leads 21 and 22 but rather lead 18. The examiners comparison of leads 21 and 22 to a pre-and post-synaptic electrode are incorrect because the device also contains an addition electrode, 18, without which the device will not function. How can a synapse, a two-terminal device, contain three electrodes? How can leads 21 and 22 be used to modify the electrical resistance when it is explicitly stated by Widrow that lead 18 is needed to provide the electroplating material needed to affect the resistance? (Widrow, C 4, L 34-55.). If the device disclosed by Widrow cannot function without lead 18 and the applicant's invention does not contain such a lead, it follows that the examiners remarks neglect the fact that the two devices are extraordinarily different In both fabrication and function.

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Simply stated, applicant's claims are not limiting to the degree that would prevent the use of the prior art of Widrow.

In reference to Applicant's argument:

The Applicant also notes that C 2, L 40-43 as well as C 3, L 18-47 of Widrow do not provide for the disclosure of a perceptron as taught by Applicant's invention. Paragraph 00329 of Applicant's invention, for example, indicates that perceptrons adjust their synaptic weights so as to produce a desired output. There is no adjustment of any synaptic weights taking place at C 2, L 40-43 as well as C 3, L. 18-47 of Widrow. Where is a synaptic weight even taught by Widrow? As Applicant's specification indications, a perceptron is essentially a "read-out" neuron. The exact rule that the read-out neurons utilize may vary, but In general such readout neurons can form a simple linear mapping between neural circuits within an LSM and the read-out neuron output. Such features are not taught, suggested or disclosed by Widrow.

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Applicant's argument is not proper.

In reference to Applicant's argument:

The Applicant also points out the Examiner's use of the word "reaction" and notes that Applicant's invention does not rely on a chemical process (i.e., a chemical reaction), but rather an electro-mechanical force created by divergent electric fields. The Examiner's comment that the components of the device disclosed by Widrow are particles in the order of 10^-9 neglects the fact that the device in its entirety is on the scale of centimeters. The Applicant respectfully points out that all systems in the known universe are constructed from material at the nanometer, or sub-nanometer scale, but this does not make the systems or devices nano-scale.

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Intent of "nanotechnology" has been addressed above. Widrow's device functions at the "nano" level.

In reference to Applicant's argument:

There is simply no teaching in Widrow of an LSM that stores, via patterns of neural activations, it's recent past history, nor of an ISM that provides "analog fading memory". Contrary to the Examiner's assertion, C 4, L34-55 of Widrow and the discussion of the electrode and liquid electrolyte that changes state to reflect changes in information, via resistivity, of Widrow, is not an LSM as taught by Applicant's invention. The Examiner has seemingly interpreted a liquid state machine to mean that the device exists in a liquid when in fact the term is used to describe the dynamics of the neural algorithm and has nothing to do with liquid. The electrode, liquid electrolyte and resistivity of Widrow do not result in a device that can store. via patterns of neural activations, it's recent past history. In fact, this is impossible because the circuit(s) disclosed by Windrow do not possess the correct topology to function as a Liquid State Machine. More specifically, a liquid state machine requires feedback to circulate neural activations within the network to act as an analog fading memory. Feed-forward neural networks do not possess these feedback connections and consequently do not provide for "analog fading memory" as taught by Applicant's invention.

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Simply stated, arguments are improper since such limitations are not in the referenced claim 12.

In reference to Applicant's argument:

Additionally, Widrow does not disclose, suggest or teach a "physical neural network" as taught by Applicant's invention. Applicant's specification refers to particular type of physical neural network, one which is based on nanotechnology. Widrow does not provide for a teaching and/or disclosure or such molecular technology (e-g., nanotechnology) as a basis for forming a physical neural network. In particular, Widrow does not provide a teaching for a nanotechnology-based neural network in which molecular neural connections are formed in a dielectric solution. C 1-12 of Widrow does not provide for any teaching of neural network connections formed in a dielectric solution. Additionally, C 1, L 10-14 and L 40-48 of Widrow cited by the Examiner does not provide for any teaching of a physical neural network as taught by Applicant's claims and specification. The mere presence of "an adaptive or learning logic network that automatically modifies its own structure" does not provide for a disclosure and/or teaching of the physical neural network taught by Applicant's invention. How does an "adaptive or learning logic network" constitute a physical neural network formed from nanotechnology S-M to by Applicant's invention?

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. All issues have been addressed in the First Office Action and further discussed above. PHOSITA recognizes Widrow as neural network technology to include Fig. 1.

In reference to Applicant's argument:

Regarding the assertion that C 4, L 35 - L 65 of Widrow teach pre- and postsynaptic electrodes, the Applicant notes that C 4, L 35 - L 65 does not provide for any teaching of pre and post synaptic electrodes as taught by Applicant's invention. In fact, C 4, L 35 - L 65 does not even refer to a synapse, let alone a physical neural network. The leads 21 and 22 of Widrow are just that - leads, and do not provide for any teaching of pre and post synaptic electrodes as taught by Applicant's invention, nor any disclosure, hint or suggestion of molecular (e.g., nanotechnology) physical neural network connections formed In a dielectric network and which can be strengthened or weakened according to an application of an electric field, a frequency of a combination thereof. C 4, L 24-27 and C 4, 49-55 does not disclose these features. The Examiner's argument that a frequency is inherent in an alternating current, does not provide for any teaching of the physical neural network connections formed in a dielectric solution as taught by Applicant's invention or the strengthening or weakening of such neural network connections according to an application of an electric field, a frequency of a combination thereof. Changing the alternating current of Widrow does not result in the use of a frequency to alter neural network connections formed in a dielectric solution (Note: Widrow does not teach such a dielectric solution). Widrow simply provides no teaching of using frequency to strengthen or weaken neural network connections formed in a dielectric solution. It should also be pointed out that that the invention disclosed by Widrow and Applicant's invention are based on completely different physical mechanisms, i.e., electrochemical (Widrow) versus electromechanical (Applicant). Any extrinsic similarities are erroneous because the underlying intrinsic physical mechanisms that enable each device are completely different from one another. One rather apparent example of the different underlying physical mechanisms is simply that the device disclosed by Widrow requires three terminals to operate, whereas the device disclosed by the Applicant requires only two (e.g., a pre- and post-synaptic electrode). The Applicant respectfully asks the examiner to explain how the invention of Widrow can be made to accomplish the tasks of Applicant's invention with the use of only two electrodes?

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest

reasonable sense. PHOSITA understands the meaning of alternating current with positive and negative fields. Obviously, Widrow 's disclosure addresses the use of a solution. Again the argument is improper since claim 12 does not limit to only two electrodes ... further, note the term "comprising."

In reference to Applicant's argument:

It is important to note that Widrow also simply does not provide for any teaching of the nanotechnology - based connections of Applicant's invention. The nanotechnology-based connections of Applicant's Invention are based on technologies that did not even exist at the time of Widrow. That is, the nanotechnology-based connections of Applicant's invention utilize components such as nanotubes, nanowires, nanoparticles and so forth. Such nanotechnology-based components and process are not taught or disclosed by Widrow, as they did not exist at the time.

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. See above discussion concerning "nano."

In reference to Applicant's argument:

It is important to note that Widrow does not provide for any teaching of nanotechnology (or microfabrication for that matter). Applicant's specification, on the other hand, provides for a teaching of nanotechnology (see paragraphs 00160017 of Applicant's specification) as follows:

> "[0016] The term "Nanotechnology" generally refers to manometer-scale manufacturing processes, materials and devices, as associated with, for example, manometer-scale lithography and manometer-scale information storage. Nanometer-scale components find utility in a wide variety of fields, particularly in the fabrication of microelectrical and microelectromechanical systems (commonly referred to as "MEMS"). Microelectrical nano-sized components include transistors, resistors, capacitors and other nano-integrated circuit components. MEMS devices include, for example, micro-sensors, micro-actuators, micro-Instruments, micro-optics, and the like.
> (0017] In general, nanotechnology presents a solution to the problems faced in the rapid pace of computer chip design in recent years. According to Moore's law, the number of switches that can be produced on a computer chip has doubled every 18 months. Chips now can told millions of transistors. It is, however, becoming increasingly difficult to increase the number of elements on a chip utilizing existing technologies. At the present rate, in the next few years the theoretical limit

> of silicon-based chips will have been attained. Because the number of elements and components that can be manufactured on a chip determines the data storage and processing capabilities of microchips, new technologies are required for the development of higher performance chips."

There is absolutely no teaching in Widrow for such nanotechnology. Where are nanometer scale (or less) components taught by Widrow? The device, as disclosed by Widrow, was contained in a glass vile and is implemented on the scale of centimeters, not nanometers. A review of Widrow does not indicate any disclosure of nanometer scale components such as nanotubes, nanowires, nanoparticles and the like. Widrow also does not provide, for example, any disclosure or teaching of manometer-scale manufacturing processes, materials and devices.

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Widrow does not address centimeters. See above discussion concerning "nano."

In reference to Applicant's argument:

Additionally, It Is important to note that Widrow does not even provide any teaching or disclosure of a neural network. Where is a teaching of a neural network in Widrow? Widrow provides no teaching of a neural network as taught by Applicant's Invention. There is no hint or suggestion of neural network components such as synapses, neurons and so forth. The "logic memory" taught by Widrow provides no indication of a neural network and In particular, no teaching of a physical neural network as taught by Applicant's invention.

In order to function as a neural network, the device of Widrow must have certain components inherent to a neural network, such as synapses, neurons and so forth. Applicant's specification at paragraphs [009-0014] generally describes some of the features of a neural network and the problems with hardware versus software implementations of neural networks;

> Neural networks that have been developed to date are largely software based. A true neural network (e.g., the human brain) is massively parallel (and therefore very fast computationally) and very adaptable. For example, half of a human brain can suffer a lesion early in its development and not seriously affect its performance. Software simulations are slow because during the learning phase a standard computer must serially calculate connection strengths. When the networks get larger (and therefore more powerful and useful), the computational time becomes enormous.
>
> For example, networks with 10,000 connections can easily overwhelm a computer. In comparison, the human brain has about 100 billion neurons, each of which can be connected to about 5,000 other neurons. On the other hand, if a network is trained to perform a specific task, perhaps taking many days or months to train, the final useful result can be built or "downloaded"

onto a piece of hardware and also mass-produced. Because most problems requiring complex pattern recognition are highly specific, networks are task-specific. Thus, users usually provide their own, task-specific training data.

A number of software simulations of neural networks have been developed. Because software simulations are performed on conventional sequential computers, however, they do not take advantage of the inherent parallelism of neural network architectures. Consequently, they are relatively slow. One frequently used measurement of the speed of a neural network processor is the number of interconnections it can perform per second.

For example, the fastest software simulations available can perform up to approximately 18 million Interconnects per second. Such speeds, however, currently require expensive super computers to achieve. Even so, approximately 18 million interconnects per second is still too slow to perform many classes of pattern classification tasks in real time. These include radar target classifications, sonar target classification, automatic speaker identification, automatic speech recognition, electro-cardiogram analysis, etc.

The implementation of neural network systems has lagged somewhat behind their theoretical potential due to the difficulties in building neural network hardware. This is primarily because of the large numbers of neurons and weighted connections required. The emulation of even of the simplest biological nervous systems would require neurons and connections numbering in the millions and/or billions.

Due to the difficulties in constructing such highly interconnected processors, currently available neural network hardware systems have not approached this level of complexity. Another disadvantage of hardware systems is that they typically are often custom designed and configured to implement one particular neural network architecture and are not easily, if at all, reconfigurable in implementing different architectures. A true physical neural network chip with the learning abilities and connectivity of a biological network has not yet bee designed and successful implemented.

Widrow does not teach weighted connections, nor neurons, synapse, nor a device which can emulate a simple biological neural network. Again, the Applicant asks, where and how is a neural network taught by Widrow?

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Argument is not proper since the argument has not been directed to a specific claim. Notwithstanding the issue of relevancy, PHOSITA, upon which the examination is based, would recognize the disclosure of Widrow to be fundamental to neural technology and see in Fig.1 the various features of a neuron.

In reference to Applicant's argument:

Additionally, the Applicant notes that Widrow could not possibly provide a teaching of strengthening connections via pre- and post-synaptic activity because the device described by Widrow does not modify its resistance via leads 21 and 22 but rather lead 18. The examiners comparison of leads 21 and 22 to a pre-and post-synaptic electrode are incorrect because the device also contains an addition electrode, 18, without which the device will not function. How can a synapse, a two-terminal device, contain three electrodes? How can leads 21 and 22 be used to modify the electrical resistance when it is explicitly stated by Widrow that lead 18 is needed to provide the electroplating material needed to affect the resistance? (Widrow, C 4, L 34-55.). If the device disclosed by Widrow cannot function without lead 18 and the applicant's invention does not contain such a lead, it follows that the examiners remarks neglect the fact that the two devices are extraordinarily different in both fabrication and function.

Examiner's response:

¶ 13. applies. The claims and only the claims form the metes and bounds of the invention. Limitations appearing in the specification but not recited in the claim are not read into the claim. The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Such limitation related to terminals is not explicitly addressed by the applicant. Applicant's argument is improper.

EN: All other arguments presented by the applicant have been addressed in related discussions above.

Examination Considerations

10. The claims and only the claims form the metes and bounds of the invention. "Office personnel are to give the claims their broadest reasonable interpretation in light of the supporting disclosure. *In re Morris,* 127 F.3d 1048, 1054-55, 44USPQ2d 1023, 1027-28 (Fed. Cir. 1997). Limitations appearing in the specification but not recited in

the claim are not read into the claim. *In re Prater*, 415 F.2d, 1393, 1404-05, 162 USPQ 541, 550-551 (CCPA 1969)" (MPEP p 2100-8, c 2, l 45-48; p 2100-9, c 1, l 1-4). The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Examiner will reference prior art using terminology familiar to one of ordinary skill in the art. Such an approach is broad in concept and can be either explicit or implicit in meaning.

11. Examiner's Notes are provided with the cited references to prior art to assist the applicant to better understand the nature of the prior art, application of such prior art and, as appropriate, to further indicate other prior art that maybe applied in other office actions. Such comments are entirely consistent with the intent and spirit of compact prosecution. However, and unless otherwise stated, the Examiner's Notes are not prior art but a link to prior art that one of ordinary skill in the art would find inherently appropriate.

12. Unless otherwise annotated, Examiner's statements are to be interpreted in reference to that of one of ordinary skill in the art. Statements made in reference to the condition of the disclosure constitute, on the face of it, the basis and such would be obvious to one of ordinary skill in the art, establishing thereby an inherent prima facie statement.

13. Examiner's Opinion: ¶¶ 10-12 apply. The Examiner has full latitude to interpret each claim in the broadest reasonable sense.

Conclusion

14. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

15. Claims 1-20 are rejected.

Correspondence Information

16. Any inquiry concerning this information or related to the subject disclosure should be directed to the Primary Examiner, Joseph P. Hirl, whose telephone number is (571) 272-3685. The Examiner can be reached on Monday – Thursday from 6:00 a.m. to 4:30 p.m.

If attempts to reach the Examiner by telephone are unsuccessful, the

Examiner's supervisor, David R. Vincent can be reached at (571) 272-3080.

Any response to this office action should be mailed to:

Commissioner of Patents and Trademarks,

Washington, D. C. 20231;

Hand delivered to:

Receptionist,

Customer Service Window,

Randolph Building,

401 Dulany Street,

Alexandria, Virginia 22313,

(located on the first floor of the south side of the Randolph Building);

or faxed to:

(571) 273-8300 (for formal communications intended for entry.

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Joseph P. Hirl
Primary Examiner
August 15, 2006